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**MEMORANDUM**

TO: Interested Parties

FROM: Paul W. Locke, Division Director, MADEP BWSC – Policy & Program Development

DATE: March 30, 2005

SUBJECT: Petroleum Constituents in GW-1 Areas

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In 2004, MADEP Waste Site Cleanup staff initiated the following discussion following the receipt of a draft paper entitled Status of Gasoline-Related Hazardous Waste Sites in Sensitive Groundwater Resource Areas in Massachusetts by Henry Lord and Ralph Tella. In the paper, the authors note that *“Of the 199 identified [gasoline-related hazardous waste sites] situated within sensitive groundwater resource areas in Massachusetts, no gasoline service stations situated in a zone of contribution to a public drinking water supply have achieved regulatory closure.”*

DEP staff have wrestled with similar concerns: the risk assessment and management approach applied under the MCP does not allow exceptions for considering factors unique to petroleum compounds, particularly a high rate of biodegradation. The lighter constituents of gasoline<sup>1</sup> and fuel oil tend to biodegrade within a short distance from the source. While heavier constituents do not degrade as rapidly, they are also not as mobile and do not migrate far from the source. In most cases the impact from a release of petroleum is likely to be limited to the immediately surrounding area.

With the recent addition of the SWAP-delineated Zone II's, many GW-1 areas now stretch several miles from the public water supply well of concern. Petroleum sites distant from the well that fall within the Zone II are subject to the stringent standards applicable to GW-1 groundwater, regardless of the likelihood that the contamination will reach the well.

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<sup>1</sup> Notable exceptions exist, like methyl tertiary butyl ether, or MTBE.

This information is available in alternate format. Call Donald M. Gomes, ADA Coordinator at 617-556-1057. TDD Service - 1-800-298-2207.

Not all GW-1 areas are delineated by sprawling Zone II's of large public water supplies. GW-1 areas around small public water supplies are described by Interim Wellhead Protection Areas, and the MCP establishes similar zones of protection around private wells. Thus private and small public wells are inherently more susceptible to localized petroleum contamination. In addition, some GW-1 areas are based on protecting an aquifer for future drinking water use of the groundwater, so a well (public or private) could be located anywhere within the protected area.

Following preliminary discussions, DEP decided to investigate the potential for revising the MCP risk characterization approach for petroleum hydrocarbons in certain GW-1 areas, with certain limitations:

1. Any movement toward flexibility on this issue would be limited to petroleum-related compounds, excluding additives such as MtBE.
2. Further research would be needed to demonstrate that petroleum-related contamination is not a significant issue for public water supplies.
3. Flexibility may be appropriate for GW-1 areas defined by Zone II's of existing public water supply wells, where the distances can be substantial and the current and future exposures defined.
4. Further research would be needed to establish whether the existing Zone II's are sufficiently distinct from other protected aquifers (e.g., Potentially Productive Aquifers, or PPA's) to justify developing a different regulatory approach.

This memorandum attempts to clarify the two points (#2 and #4) requiring further research.

## Point #2: Petroleum Constituents in Public Water Supplies – A Summary of Current Conditions

*Are petroleum products significant contributors to contamination at public water supplies?*

To answer this question, the MADEP Bureau of Waste Site Cleanup (“BWSC”) requested a record from the Drinking Water Program of every MCL exceedance for BTEX and MTBE in public water supplies<sup>2</sup>. The data was filtered so only detections above the MCLs or the MTBE ORSG would appear, but no BTEX and very few MTBE records came up. (It was noted that while this is surprising, it is consistent with the fact that DEP has never had an MCL violation for any of the BTEX compounds as far back as 1993 – the start of the EPICS database). The Drinking Water program provided BWSC with a spreadsheet detailing every BTEX and MTBE **detection** since 2000. Table 1 summarizes the results.

Table 1.  
BTEX and MTBE Detections in Public Water Supplies  
January 2000 – April 2004

Chemical	# Unique Water Supplies	Total # Detections				Median µg/L	Avg µg/L	Range µg/L	Standard µg/L	# Hits Greater Than Standard
		Comm	NC	NTNC	Total					
Benzene	8	21	1	1	23	0.7	0.8	0.15 – 3.3	5	0
Ethylbenzene	19	33	0	1	34	1	2.3	0.5 – 33	700	0
Toluene	50	37	6	28	71	1	2.5	0.5 - 14	1,000	0
Xylenes	43	69	3	7	79	1.9	3.9	0.5 - 53	10,000	0
MTBE	223	845	149	149	1,143	1.2	4.1	0.4 - 240	70	7 (2 systems)
Comm: Community Drinking Water Supply NC: Non-Community Drinking Water Supply NTNC: Non-Transient Non-Community Drinking Water Supply										

Most of the samples analyzed were of finished water. Approximately 13% of the analyses were conducted on raw water, an indication that a treatment system was in place (most likely to address chlorinated VOCs). The concentrations in the raw water tend to be slightly lower on average than the finished water results.<sup>3</sup>

Figures 1 through 5 depict the distributions of the data to better illustrate the levels found in public water supplies relative to the standards.

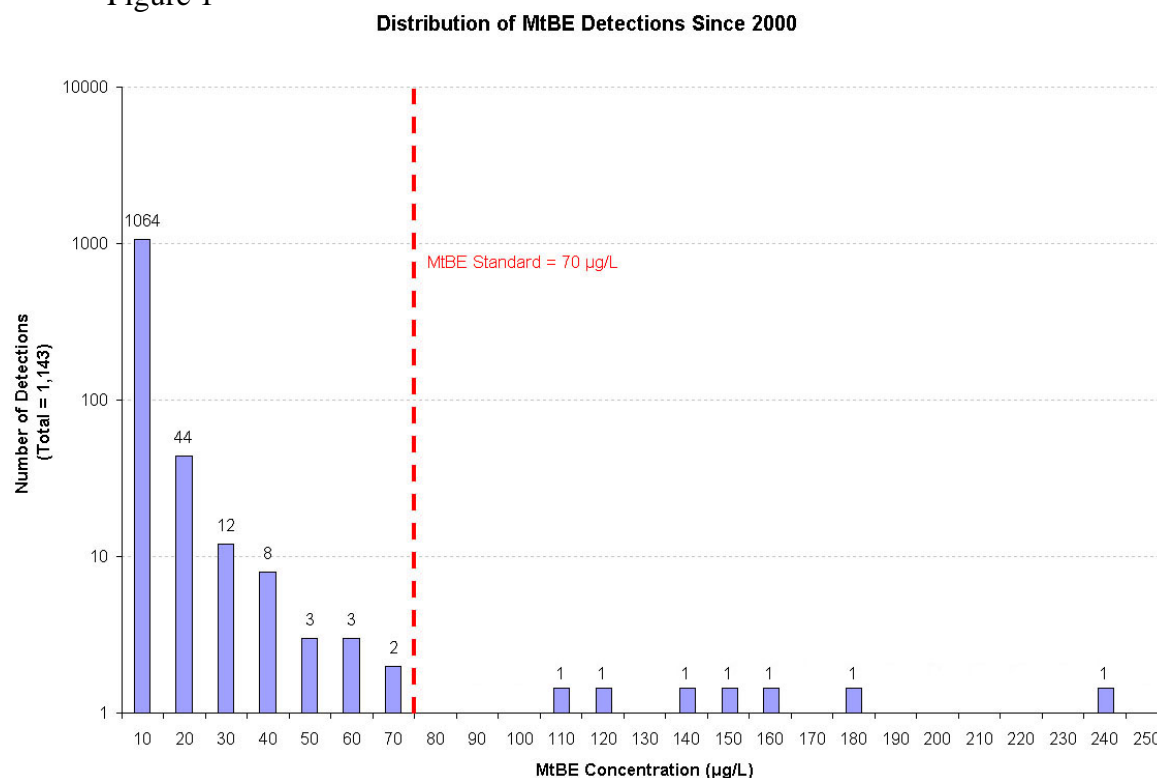
<sup>2</sup> Other petroleum constituents, such as ethylene dibromide (EDB) and the VPH/EPH ranges were not included in this analysis.

<sup>3</sup> This finding appears counterintuitive: you would expect the finished (treated) water to be less contaminated than raw (untreated) water. However “finished” water does not mean that the water was “treated” for VOCs – just that it is the water provided to consumers. Most of the “finished” water was not, in fact, treated for VOCs. The small differences in concentration between the raw and finished water samples are probably statistically meaningless.

## Conclusions

1. While petroleum products are ubiquitous and account for approximately 75 percent of the reported releases to DEP BWSC, BTEX compounds are not found in public drinking water supplies at levels approaching the applicable standards.
2. Due to its significant solubility and resistance to biodegradation, MtBE is more commonly detected in public water supplies. However, only two public water systems<sup>4</sup> have reported concentrations greater than the ORSG of 70 µg/L.

Figure 1



<sup>4</sup> Westview Farm (Monson, RTN 1-0012147) is currently in “Remedy Operation Status” under the MCP and the United Methodist Church (Wellfleet, RTN 4-0015960) is a Tier 1D site.

Figure 2

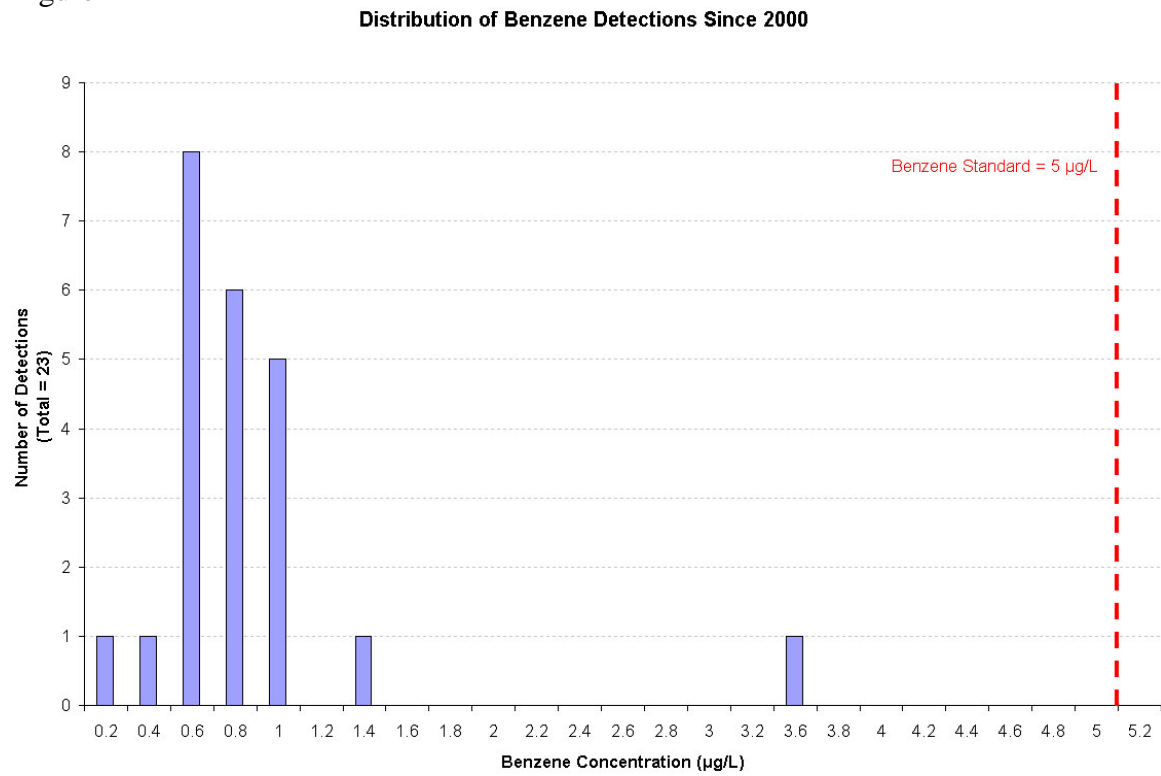


Figure 3

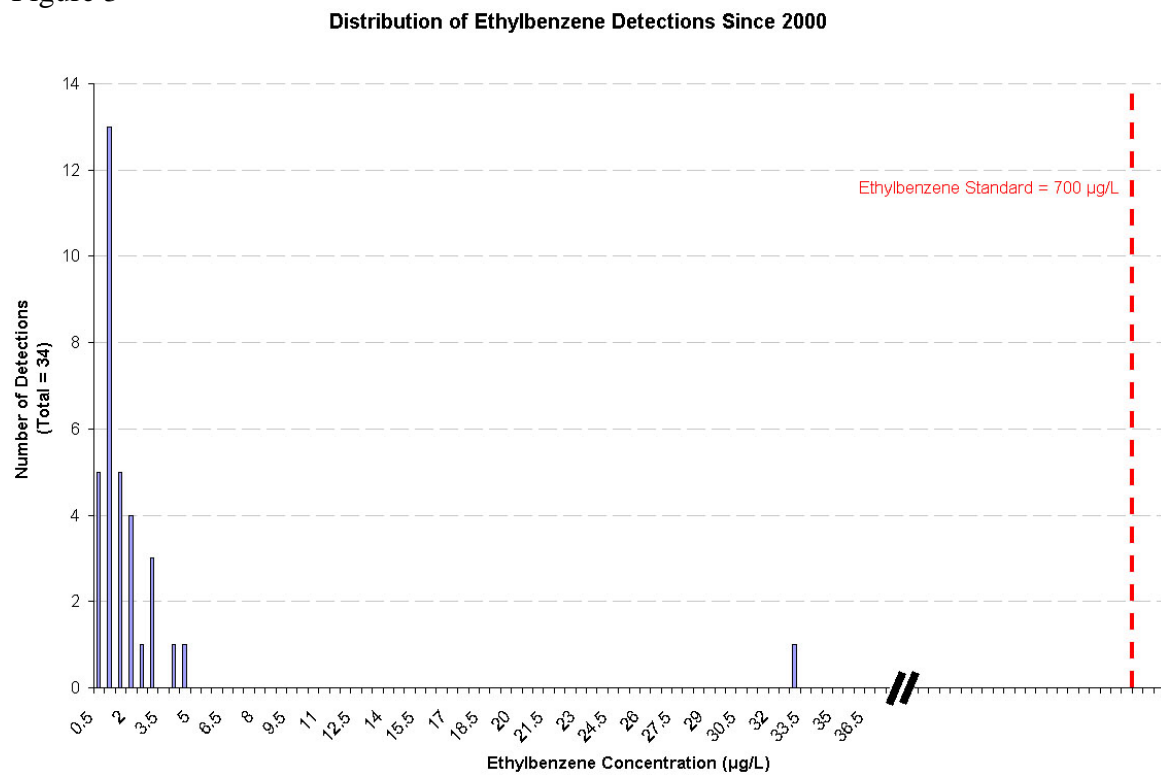


Figure 4

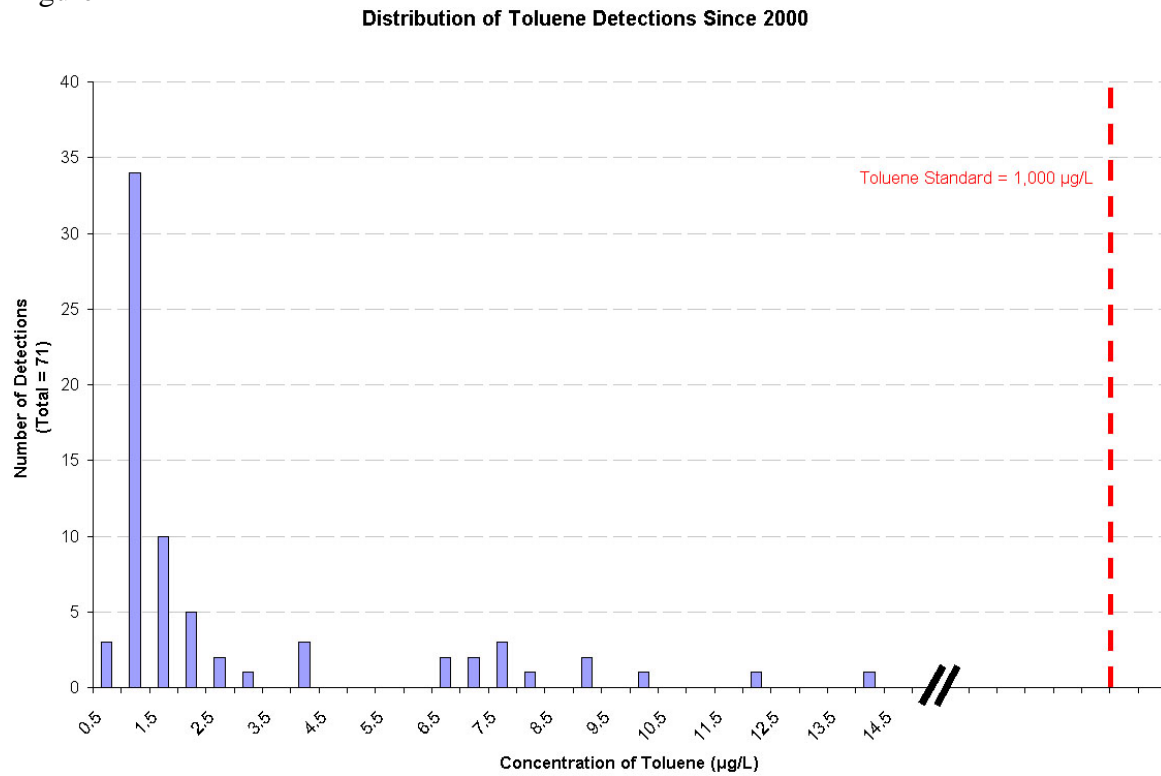
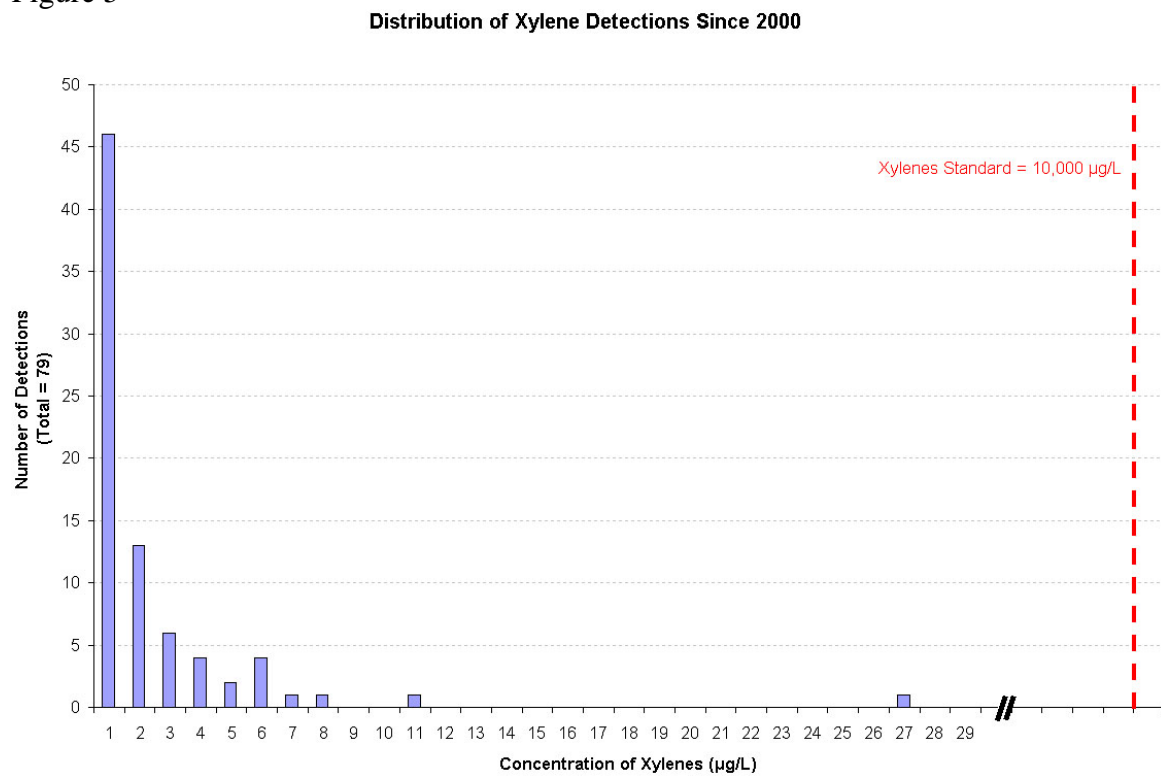


Figure 5



**Point #4: Areas of Concern: Zone II's and Potentially Productive Aquifers (PPA's)**

*Are Zone II's sufficiently distinct from PPA's to warrant a separate regulatory approach to risk characterization?*

The MCP establishes several criteria to categorize groundwater as GW-1, based on the current and potential future use of the aquifer. Groundwater is designated GW-1 based on current use if it is within a Zone II or IWPA of a public water supply, within a Zone A of a Class A surface water supply, or if it is within 500 feet of an existing private well. Groundwater is designated as GW-1 based on potential future use if it is within a Potentially Productive Aquifer, within a locally designated aquifer protection district, or more than 500 feet beyond a public water distribution line. PPA's are based on the yield of an aquifer, or the ability to pump sufficient quantities of water to support a public water supply well (i.e., medium- and high-yield aquifers, as determined by USGS).

If an existing Zone II is coincidental with a PPA, then the aquifer is being protected both for its current use (Zone II) and the potential for the development of one or more additional wells somewhere within the PPA.

DEP is interested in providing flexibility in meeting the petroleum-related standards in groundwater **only** in those areas where the likelihood of additional future wells (public and private) is small: those areas designated GW-1 solely on the basis of a delineated Zone II.

**Zone II's**

- There are 528 delineated Zone II's in Massachusetts, covering 528,924 acres<sup>5</sup>.
- The average Zone II covers 1002 acres; they range in size from 1.6 to 12,308 acres.

**PPAs**

- There are 578 "High Yield" aquifers, covering 228,738 acres (396 acre average).
- There are 997 "Medium Yield" aquifers, covering 355,288 acres (356 acre average).
- There are 359,589 acres on Cape Cod, Martha's Vineyard, Nantucket and the Elizabeth Islands designated as Potentially Productive Aquifers by regulation.
- The total unique area designated as PPA is 878,990 acres.<sup>6</sup>

**OVERLAP**

- Outside of Cape Cod, 16,955 acres are within **both** a Zone II and a Potentially Productive Aquifer. On the Cape (which is a PPA by definition), all 88,135 acres of the Zone II's overlap with a PPA.
- The total area of overlap between Zone II's and PPA's is approximately 105,090 acres, or about 20 percent of the Zone II's.
- The actual public water supply well invariably falls within a PPA.
- Approximately 80 percent of the Zone II area falls outside the PPA designation.

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<sup>5</sup> Massachusetts encompasses 7,838 square miles, or 5,016,320 acres.

<sup>6</sup> 64,626 acres of Medium/High Yield Aquifers on Nantucket and Martha's Vineyard are doubled counted and are subtracted from the total.

- Figure 6 shows the Zone II's (magenta outline and crosshatch) and PPA's (green fill) across the state. Figure 7 looks at a close-up example using the suburbs northwest of Boston. In this map, the blue fill indicates where a Zone II overlaps with a PPA.

### Conclusions:

1. A significant proportion of the delineated Zone II's are not within Potentially Productive Aquifers.
2. This information would support efforts to provide greater risk assessment/risk management flexibility for petroleum-related compounds within Zone II's.

Figure 6 - Zone II's (magenta, cross-hatched) and PPA's (green, filled) Across Massachusetts

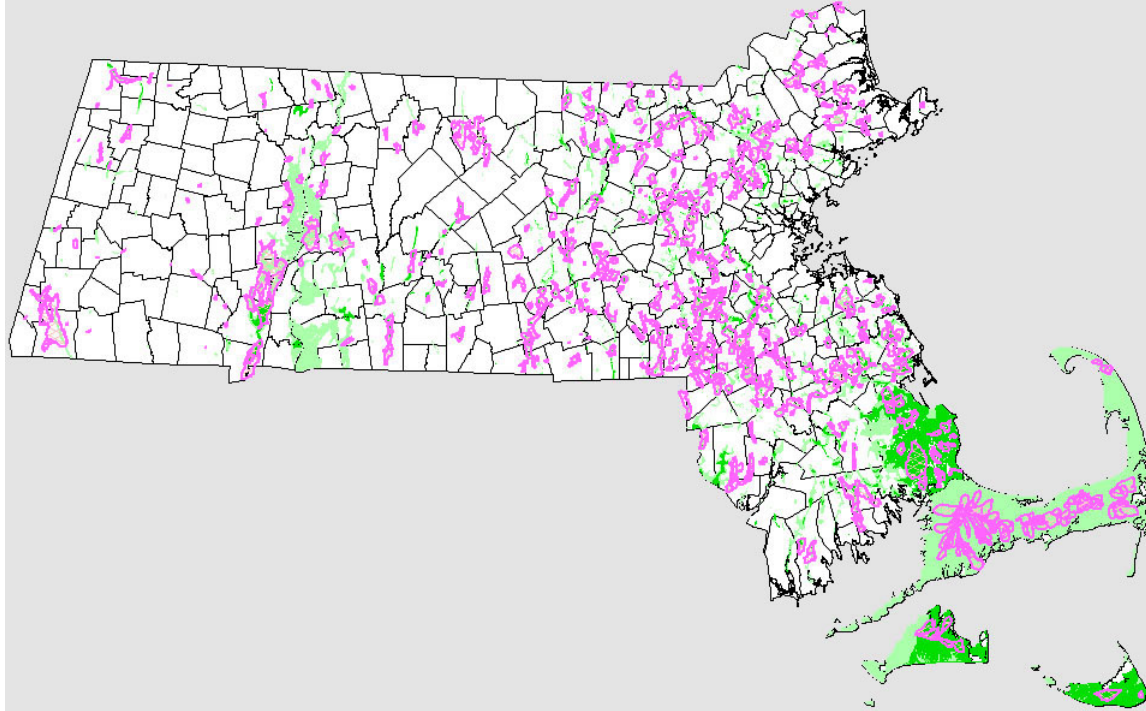




Figure 7 – Intersection (blue, filled) of Zone II's (magenta, cross-hatched) and PPA's (green, filled) Northwest of Boston

